Installing and Removing The MuID Collar

procedure name

PHENIX Procedure No. PP-2.5.5.4-25

Revision: D **Date: 6/23/2016**

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

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REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	WRITTEN BY	APPROVED BY	CURRENT OVERSIGHT
A	First Issue (Note: minor formatting and clarifying changes requested by Steve Kane for engineered lift evaluation incorporated after Rev A signatures but prior to release of Rev A.	07/09/2007	D. Lynch	D. Lynch, E. O'Brien, P. Giannotti, C. Pearson + Steve Kane& Michael Bebon approval of CLEF as engineered lift	D. Lynch
B	Reviewed for Accuracy. No changes made	5/20/2010	D. Lynch	D. Lynch, P. Giannotti, R. Pisani	D. Lynch
C	3 year review with no changes to content. New rev letter and date	6/4/2013	D. Lynch	D. Lynch, P. Giannotti, R. Pisani	D. Lynch
D	3 year review with no changes to content, except minor format changes as previously carried on HPC Page. New rev letter and date	6/23/2016	D. Lynch	D. Lynch, P. Giannotti, R. Pisani	D. Lynch

1.0 Purpose & Scope

1.1 The purpose of this procedure is to provide directions for the installation and removal of the MuID collar. The collar is a required shielding element for the PHENIX Muon Identifier detector subsystem and it must be installed prior to any PHENIX experiment run. Conversely, the South Muon Magnet (MMS) can not be moved unless the collar is first removed. In general, the MMS needs to be moved several times during major maintenance shutdowns of the PHENIX experiment. These shutdowns occur between annual experimental runs so that typically the collars would need to be installed and removed once each year.

1.2 Installation and removal of the MuID collar is a delicate operation involving the installation of a 7 ton collar around a thin stainless steel beampipe immediately south of the PHENIX interaction point.

1.3 This procedure covers the procedure for performing MuID collar lifts, installation and removal. This procedure should be invoked by a specific work plan for each performance of the tasks described herein. Such a work plan shall designate specific persons to assume the roles of "person-in-charge" "crane operator" and "lift support personnel" as defined generically herein.

2.0 Responsibilities

2.1 All operations shall be performed under the direction of the "Person-in-Charge" or his designee.

2.2 All persons involved in this operation shall maintain a distraction free environment and shall remain fully focused on this task alone throughout the operation.

2.3 The person-in-charge shall ensure that all persons not involved in this operation shall stay clear from the area of this operation for the duration of the operation.

3.0 Prerequisites

3.1 Training: All persons involved in the operations described in this procedure shall have current training in PHENIX Awareness, C-A Access, Crane operator, rigging for crane operations and working at heights

3.2 All persons involved in the operations described in this procedure shall have read and reviewed this procedure prior to commencing this operation.

3.3 In addition to the person-in-charge, at least two technicians are to be assigned to conduct this procedure, with their sole focus being on the installation/removal of the MuID Collars as appropriate.

3.4 The lifting equipment (crane, shackles, attaching hardware, slings, chain fall, etc. shall have had documented certification of a current valid inspection stickers and shall be 100% visually inspected for defects immediately prior to commencing this operation.

3.5 A pre-lift meeting shall be held by the person-in-charge of the lift, and all other persons involved in the operation. At the meeting this procedure will be reviewed and acknowledged by each person involved so that each operator is fully aware of his responsibilities and each other person's responsibilities in this task.

3.6 Prior to commencing the tasks defined in this procedure, the C-A vacuum group is to be notified and a request made to close the vacuum isolation valves at the north and south of the PHENIX .

4.0 Precautions

4.1 There is a potential for personnel and/or equipment injury/damage during this operation in the event of a lift failure. Personnel and portable equipment not specifically involved in this procedure shall be kept clear of the task area for the duration of the task.

4.2 There is a potential of damaging the stainless steel beampipe (which the subject collar is intended to surround) during installation due to crane operator error or equipment malfunction. Accordingly maximum care shall be taken to prevent sudden or jerky moves on the crane which could cause the load to swing. In addition the collar is to be oriented into its installation position sufficiently away from the beampipe to assure that the load, slings and lifting apparatus can not contact the beampipe during the load orientation process.

4.3 There is a potential for pinching and crushing fingers or other personal appendages between the south muon magnet (MMS) and the MuID collar during installation. Maximum care shall be taken by the operators to prevent positioning any body parts between the collar and the MMS during the installation operation. ***Note: There is likely to be residual magnetism in the collar and/or the MMS collar attachment point which would cause the collar to "snap" onto the magnet when in close proximity.***

5.0 Procedure

Figure 1 is a plan view of the area in the PHENIX IR where the MuID collars are pre-positioned prior to the installation described herein and the installed location. Figure 2 is an elevation view looking north along the beamline. Figure 3 shows the location of the center of gravity of the collar halves. Figure 4 is a schematic indicating the attachments of the lifting apparatus. All persons participating in this operation shall review and understand the procedures and figures in this document prior to undertaking the tasks described herein.

This operation requires 3 qualified technicians. In addition a cognizant engineer or scientist may be in attendance during the lift. No other personnel or equipment should be present in the immediate area of this operation. All technicians shall wear appropriate safety protective equipment (safety shoes, hard hat, gloves). Any other persons in the immediate area shall be wearing safety shoes and a hard hat.

The person in-charge shall give all instructions during the lift. The other 2 technicians shall be positioned as follows (1 on the ground operating the crane and one on the MuID platform for fine positioning of the collar and attachment of the fastening hardware.

5.1. Installing the MUID Collar

1. Lock out the MMS (lock-out tag out LOTO).

2. Contact C-A vacuum group and request that the vacuum isolation valves immediately north and south of the PHENIX IR be closed. Contact the C-A vacuum group again to verify that these valves are closed and will stay closed until completion of this procedure before the next step.

3. Clear the lift area of all personnel and equipment not involved in the installation operation. (Note: the southeast IR AC air deflector must be removed prior to operating the crane.) Raise the MMS work platform to the work position.

4. Position the IR crane with the hook directly over the central boss (center of gravity) of first (**EAST**) collar half and lower the hook to about 3 feet above the collar half.

5. Attach swivel eyes to the 3 tapped support holes as shown in figure 4. Torque the swivel eye attachment bolt to 60 ft-lbs (per manufacturer's instructions). Make sure the outboard tapped holes used are the set that will be facing up when the collar half is in its installed position (Note: there are 2 sets of tapped outboard holes on both collar halves so that the halves are identical and either half could be used as either the east or west half. For purposes of this description, outboard refers to the tapped holes adjacent to the flat side of the

collar halves.)

6. Attach the tufflex polyester 3 foot sling to the crane hook. Attach the other end of the 3 foot sling to the chain fall. Attach the other end of the chain fall to the central cg boss swivel eye using A 7/8 shackle..

7. Attach the 10 ft liftall slings to the crane hook. Attach the other end of each of these slings to each of the other 2 outboard swivel eyes using 5/8 shackles.

8. Remove all slack on the chain fall until there is some tension in the chain.

9. Begin raising the hook vertically until the collar half is about 2 feet above its rest position on the floor grating.

10. Manually rotate the collar half slowly in a horizontal plane so that the flange side of the collar half is facing north.

11. Using the chain fall extend the chain so that the collar half rotates vertically until the outboard lifting holes face vertically upward.

12. Position the collar half north-south so that it is within a few inches of the southernmost clear vertical east-west plane in the lift area. (i.e. as far as practical from the MMS during the lift)

13. Using the east-west drive for the IR crane slowly move the collar half west until the crane is near the beam pipe but no closer than 3 feet from the beam pipe. Make sure that the load is moved slowly enough so it does not sway more than 1 inch when the crane's horizontal motion is stopped or started.

14. At this point the 3 persons involved in the lift shall position themselves as follows

    a. One technician shall be standing at ground level several feet away from the collar half operating the crane controls.
    b. A second technician shall be positioned on MuID platform in position to guide the collar half to its final position.
    c. The person-in-charge (PIC) shall be at ground level near the collar half and guiding it as it ascends away from the floor. The PIC issues all commands for crane operation to the crane operator.

15. Raise the collar half until the centerline of the collar half is in the horizontal plane of the beampipe centerline.

16. With the operator on the MuID platform manually guiding the collar half, slowly move the collar half closer to the beampipe until it is in its installed east-west position.

17. With the operator on the MuID platform manually guiding the collar half, slowly move the collar half north making fine adjustments with the east-west and vertical position using the crane guiding the collar half to its final position.

18. Install the mounting bolts, alternating between upper, lower and middle bolts and using the crane to nudge the collar half as necessary until all bolts are installed. Fully tighten the bolts in the same alternating pattern.

19. Lower the crane hook slightly to create slack on the slings and chain fall, carefully observing any movement of the collar half to verify that it is fully and securely mounted to the MMS.

20. Lower the crane hook a few more inches to take all load off the slings, detach the 3 swivel eyes from the collar half and raise/move the crane as necessary to avoid contacting the collar half and/or beampipe while lowering the lifting hardware to prepare for lifting the next collar half by positioning the crane hook directly over the central boss (center of gravity) of the second (west) collar half and lower the hook to allow some slack to attach the swivel eyes to the **WEST** collar half.

21. Attach swivel eyes to the 3 tapped support holes as shown in figure 4. Torque the swivel eye attachment bolt to 60 ft-lbs (per manufacturer's instructions). Make sure the outboard tapped holes used are the set that will be facing up when the collar half is in its installed (**WEST**) position (Note: there are 2 sets of tapped outboard holes on both collar halves so that the halves are identical and either half could be used as either the east or west half. For purposes of this description, outboard refers to the tapped holes adjacent to the flat side of the collar halves.) Make sure that the swivel eye attached to the chain fall is secured to the tapped hole in the cg boss, while the swivel eyes attached to the outboard tapped holes are attached to the 10 ft liftall slings. Make sure that all slings and the chain fall are un-twisted and securely attached at either end.

22. Remove all slack on the chain fall until there is some tension in the chain.

23. Begin raising the hook vertically until the collar half is about 2 feet above its rest position on the floor grating.

24. Manually rotate the collar half slowly in a horizontal plane so that the flange side of the collar half is facing north.

25. Using the chain fall extend the chain so that the collar half rotates vertically until the outboard lifting holes face vertically upward.

26. Position the collar half north-south so that it is within a few inches of the southernmost clear vertical east-west plane in the lift area. (i.e. as far as practical from the MMS during the lift)

27. Using the east-west drive for the IR crane slowly move the collar half west until the crane is near the beam pipe but no closer than 3 feet from the already installed **EAST** collar half. Make sure that the load is moved slowly enough so it does not sway more than 1 inch when the cranes horizontal motion is stopped or started.

28. At this point the 3 persons involved in the lift shall position themselves as follows (if they are not already positioned as such):

    a. One technician shall be standing at ground level several feet away from the collar half operating the crane controls.
    b. A second technician shall be positioned on MuID platform in position to guide the collar half to its final position.
    c. The person-in-charge (PIC) shall be at ground level near the collar half and guiding it as it ascends away from the floor. The PIC issues all commands for crane operation to the crane operator.

29. Lift the collar half using the crane vertically until the bottom of the collar half is more than 4 feet above the beam pipe.

30. Move the collar half slowly west until it is 3 feet or more past (west of) the beam pipe.

31. Lower the collar half until its centerline is in the horizontal plane of the beampipe centerline.

32. With the operator on the MuID platform manually guiding the collar half, slowly move the collar half closer to the beampipe until it is in its installed east-west position.

33. With the operator on the MuID platform manually guiding the collar half, slowly move the collar half north making fine adjustments with the east-west and vertical position using the crane guiding the collar half to its final position.

34. Install the mounting bolts, alternating between upper, lower and middle bolts and using the crane to nudge the collar half as necessary until all bolts are installed. Fully tighten the bolts in the same alternating pattern.

35. Lower the crane hook slightly to create slack on the slings and chain fall, carefully observing any movement of the collar half to verify that it is fully and securely mounted to the MMS.

36. Lower the crane hook a few more inches to take all load off the slings, detach the slings, swivel eyes, shackles, etc from the collar half and raise/move the crane as necessary to avoid contacting the collar halves and/or beampipe while lifting the slings, chain fall and swivel eyes above and eastward over the collar, then lowering the lifting hardware to ground level for removal from the crane

hook and each other.

37. Properly store the slings, chain fall, shackles and swivel eyes until next needed.

38. Reinstall the southeast IR AC air deflector.

39. Remove lockout from MMS.

40. Notify C-A vacuum group that the collar installation is complete and inform the C-A vacuum group that the vacuum isolation valves immediately north and south of the PHENIX IR may now be opened.

5.2 Removing the MUID Collar

1. Lock out the MMS (lock-out tag out LOTO).

2. Contact C-A vacuum group and request that the vacuum isolation valves immediately north and south of the PHENIX IR be closed. Contact the C-A vacuum group again to verify that these valves are closed and will stay closed until completion of this procedure before the next step.

3. Clear the lift area of all personnel and equipment not involved in the installation operation. (Notes: 1- The southeast IR AC air deflector must be removed prior to operating the crane. 2- If the MMs platform is not in the up [work] position, then raise it to the work position before proceeding.)

4. Position the IR crane with the hook several feet west of the collar then lower the hook to about 3 feet above the floor. Attach one end of each of the (2) 10 ft and (1) 3 ft slings to the hook. Raise the hook about 3 feet and attach one end of the chain fall to the short sling.

5. Attach the 3 swivel eyes to the opposite ends of the 2 slings and the chain fall using the (2) 5/8 shackles and (1) 7/8 shackle.

6. At this point the 3 persons involved in the lift shall position themselves as follows

    a. One technician shall be standing at ground level several feet away from the collar halves operating the crane controls.
    b. A second technician shall be positioned on MuID platform in position to remove the attachment bolts and guide the removal of the collar half from the MMS.

    c. The person-in-charge (PIC) shall be at ground level with a clear vision of the collar halves and ready to guide it when it descends its mounted position. The PIC issues all commands for crane

operation to the crane operator.

7. Raise the hook and lifting equipment to the **WEST** collar half level then move it west until the 2 lifting eyes connected to the slings are directly above the two upper lifting holes on the collar half then attach the lifting eyes to these holes. Torque the swivel eye attachment bolt to 60 ft-lbs (per manufacturer's instructions). Raise the hook to take up the slack on the slings.

8. Adjust the chain fall length so that the swivel eye attached to the chain fall is at the level of the collar half cg tapped lifting boss and attach it.

9. Raise the crane hook enough to apply equal tension to the 2 long slings while adjusting the chain fall so that there is neither slack nor tension. Adjust the tension in the 2 long slings to be prepared to take the full load of the collar half.

10. Begin untightening the mounting bolts just enough to remove the torque on each bolt, alternating between upper, lower and middle bolts and checking the tension in the slings frequently to assure that the slings will take the full load. Use the crane to nudge the collar half as necessary until all bolts are no longer tensioned and the collar half is fully supported by the crane through the slings and the chain fall is unloaded but without slack. Fully remove all of the bolts in the same alternating pattern.

11. Slowly move the **WEST** collar half south a few inches to clear the collar mounting surface. The technician guiding the collar half should then exit the platform. Using the crane, move the collar half west about 3 feet carefully and slowly moving it to prevent any swinging motion.

12. Lift the **WEST** collar half so the bottom most edge is at least 4 feet above the beam pipe, then slowly drive the crane east taking care to prevent any swinging motion until it is more than 4 feet east of the still-installed **EAST** collar half.

13. Lower the crane until the collar half is about 6 inches off the floor then move the crane slowly east until it is above its final resting position at the southeast end of the PHENIX IR where there is a painted outline of the east and west collar halves.

14. Position the crane directly over the center of the painted outline then begin shortening the chain fall to raise the cg boss and thus rotate the collar half to its final position.

15. Lower the **WEST** collar half onto its painted outline on the floor and continue lowering the crane until there is slack in all lifting lines and all load

has been released from the crane to the floor.

16. Remove the lifting eyes from the three locations on the **WEST** collar half and raise the crane to clear the collar half.

17. At this point the 3 persons involved in the lift shall position themselves (if they are not already there) as follows

    a. One technician shall be standing at ground level several feet away from the collar half operating the crane controls.

    b. A second technician shall be positioned on MuID platform in position to guide the collar half to its final position.

    c. The person-in-charge (PIC) shall be at ground level with a clear vision of the collar half and ready to guide it when it descends its mounted position. The PIC issues all commands for crane operation to the crane operator.

18. Raise the hook and lifting equipment to the **EAST** collar half level then move it west until the 2 lifting eyes connected to the slings are directly above the two upper lifting holes on the collar half then attach the lifting eyes to these holes. Torque the swivel eye attachment bolt to 60 ft-lbs (per manufacturer's instructions). Raise the hook to take up the slack on the slings.

19. Adjust the chain fall length so that the swivel eye attached to the chain fall is at the level of the collar half cg tapped lifting boss and attach it.

20. Raise the crane hook enough to apply equal tension to the 2 long slings while adjusting the chain fall so that there is neither slack nor tension. Adjust the tension in the 2 long slings to be prepared to take the full load of the collar half.

21. Begin untightening the mounting bolts just enough to remove the torque on each bolt, alternating between upper, lower and middle bolts and checking the tension in the slings frequently to assure that the slings will take the full load. Use the crane to nudge the collar half as necessary until all bolts are no longer tensioned and the collar half is fully supported by the crane through the slings and the chain fall is unloaded but without slack. Fully remove all of the bolts in the same alternating pattern.

22. Slowly move the **EAST** collar half south a few inches to clear the collar mounting surface. The technician guiding the collar half should then exit the platform. Using the crane, move the collar half east about 3 feet carefully and slowly moving it to prevent any swinging motion.

23. Lower the crane until the collar half is about 6 inches off the floor then move the crane slowly east until it is above its final resting position at the southeast end of the PHENIX IR where there is a painted outline of the east and west collar halves.

24. Position the crane directly over the center of the painted outline then begin shortening the chain fall to raise the cg boss and thus rotate the collar half to its final position.

25. Lower the **EAST** collar half onto its painted outline on the floor and continue lowering the crane until there is slack in all lifting lines and all load has been released from the crane to the floor.

26. Remove the lifting eyes from the three locations on the **EAST** collar half and lower the crane to remove all slings and the chain fall from the crane hook.

27. Properly store the slings, chain fall, shackles and swivel eyes until next needed.

28. Reinstall the southeast IR AC air deflector.

29. Remove lockout from MMS.

30. Notify C-A vacuum group that the collar installation is complete and inform the C-A vacuum group that the vacuum isolation valves immediately north and south of the PHENIX IR may now be opened.

6.0 Documentation

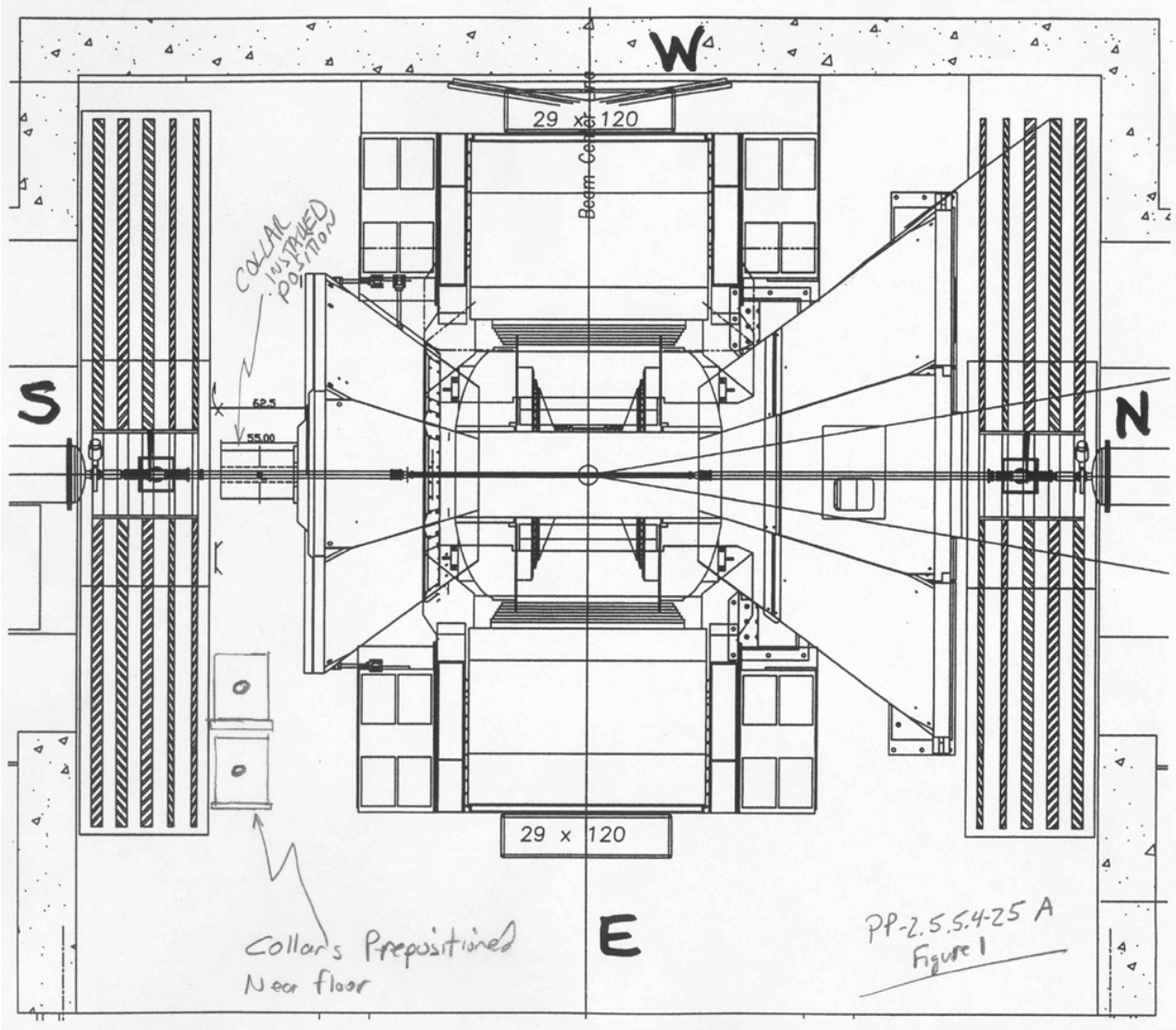
Load and cg calculations for the collar and Critical/Pre-engineered lift evaluation form for the lift described herein, structural design calculations, purchasing documentation and QC documentation for the MuID collar design and fabrication are maintained by the PHENIX configuration control system. These items are available on request.

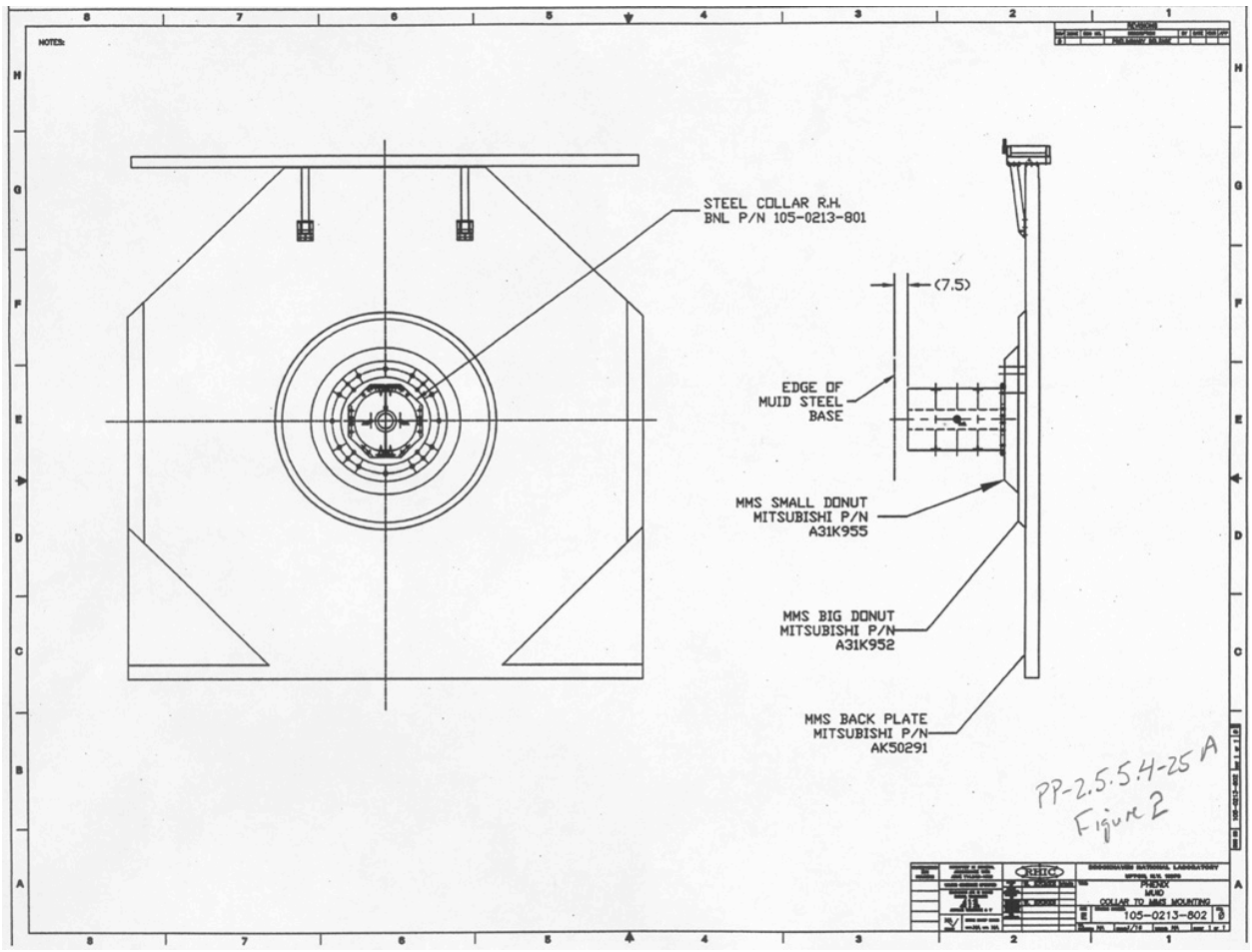
7.0 References

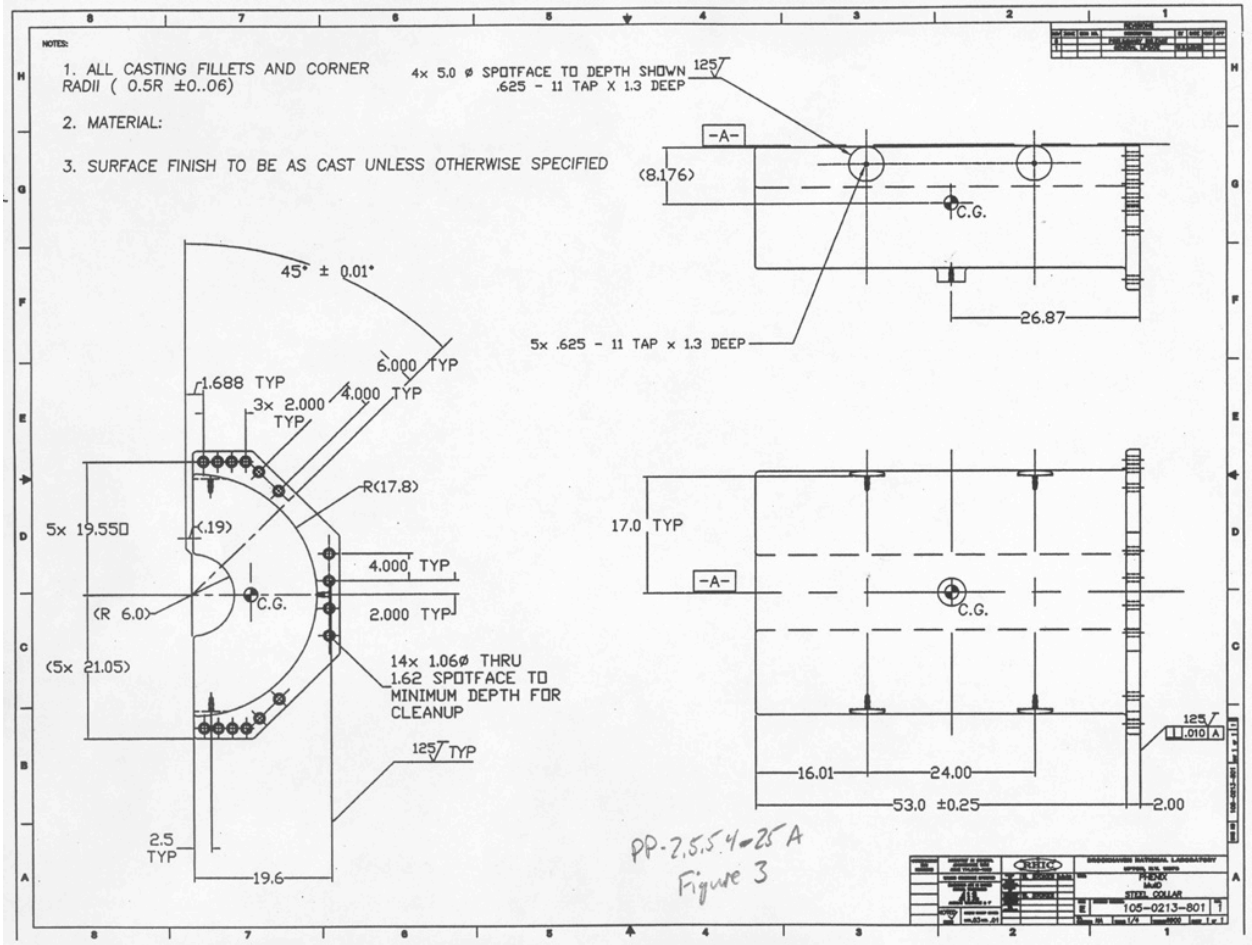
BNL Worker Safety and Health System, Lifting Safety Subject Area, 1. Conducting Critical and Pre-engineered Lifts.

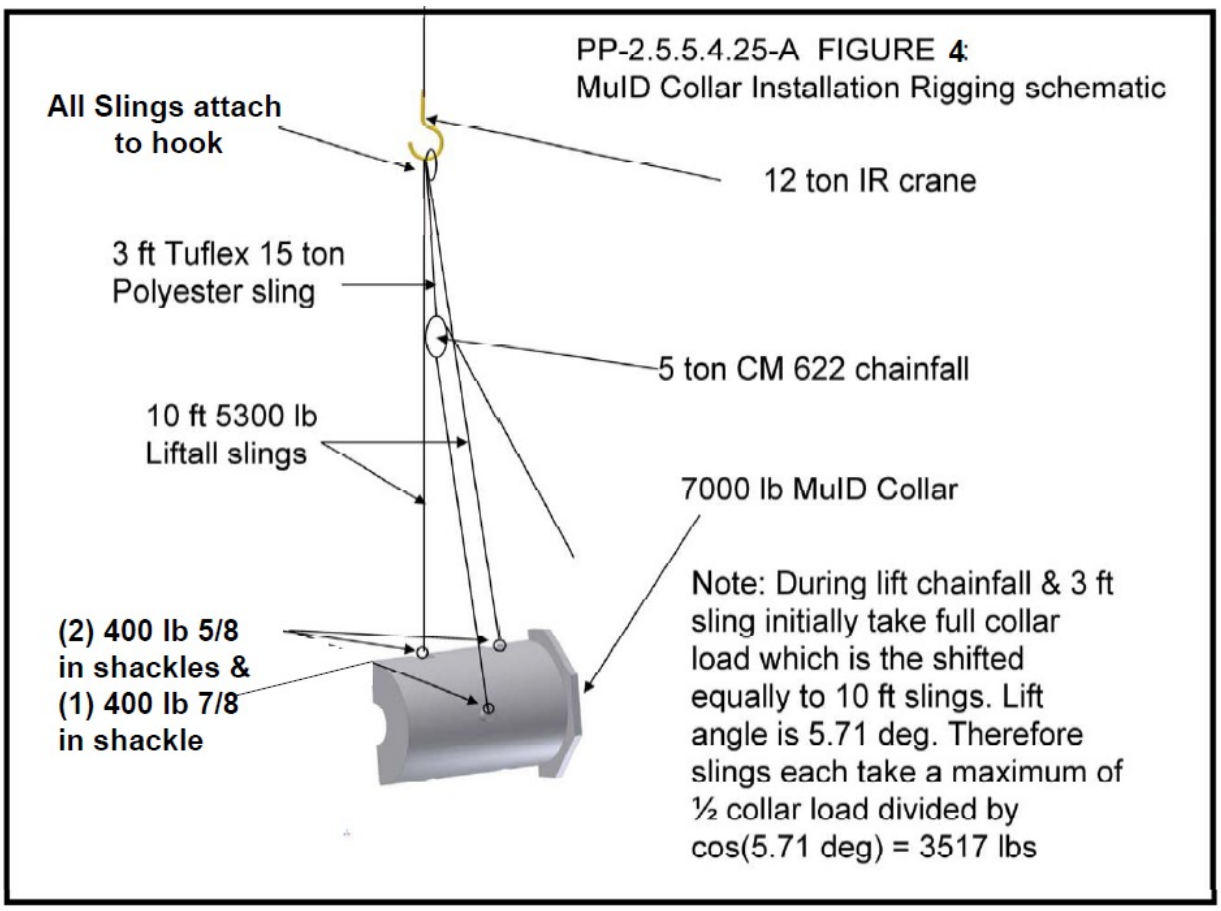
8.0 Attachments

Figure 1: Lift area plan view
Figure 2: Lift area elevation view
Figure 3: MuID collar design and cg
Figure 4: Lifting apparatus schematic


W
29 x 120
Beam Centerline
COLLAR INSTALLED POSITION
62.5
55.00
S
N
29 x 120
E
Collars Prepositioned Near floor
PP-2.5.5.4-25 A
Figure 1


STEEL COLLAR R.H.
BNL P/N 105-0213-801
(7.5)
EDGE OF
MUID STEEL
BASE
MMS SMALL DONUT
MITSUBISHI P/N
A31K955
MMS BIG DONUT
MITSUBISHI P/N
A31K952
MMS BACK PLATE
MITSUBISHI P/N
AK50291
PP-2.5.5.4-25 A
Figure 2


NOTES:
1. ALL CASTING FILLETS AND CORNER RADII (0.5R ±0..06)
2. MATERIAL:
3. SURFACE FINISH TO BE AS CAST UNLESS OTHERWISE SPECIFIED
4x 5.0 ø SPOTFACE TO DEPTH SHOWN .625 - 11 TAP X 1.3 DEEP
125
-A-
(8.176)
C.G.
26.87
5x .625 - 11 TAP x 1.3 DEEP
45° ± 0.01°
6.000 TYP
1.688 TYP
3x 2.000 TYP
4.000 TYP
R(17.8)
5x 19.550
(.19)
4.000 TYP
(R 6.0)
C.G.
2.000 TYP
(5x 21.05)
14x 1.06ø THRU
1.62 SPOTFACE TO
MINIMUM DEPTH FOR
CLEANUP
125 TYP
2.5
TYP
19.6
17.0 TYP
-A-
C.G.
125
.010 A
16.01
24.00
53.0 ±0.25
2.00
PP-2.5.5.4-25A
Figure 3
105-0213-801


PP-2.5.5.4.25-A FIGURE 4:
MuID Collar Installation Rigging schematic
All Slings attach to hook
12 ton IR crane
3 ft Tuflex 15 ton Polyester sling
5 ton CM 622 chainfall
10 ft 5300 lb Liftall slings
7000 lb MuID Collar
(2) 400 lb 5/8 in shackles & (1) 400 lb 7/8 in shackle
Note: During lift chainfall & 3 ft sling initially take full collar load which is the shifted equally to 10 ft slings. Lift angle is 5.71 deg. Therefore slings each take a maximum of ½ collar load divided by cos(5.71 deg) = 3517 lbs